AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 72

THE PARNALL "IMP"

A NEW BRITISH LIGHT AIRPLANE

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A New British Light Airplane*

In designing the "Imp," photographs of which were published in "Flight" of March 29, 1928, Mr. Harold Bolas, George Parnall's chief designer, had two outstanding fundamental aims in view, simplicity and good view. An examination of the "Imp" shows that he has attained these objects. With its entire absence of wire bracing (and consequent avoidance of any need for ever truing-up the airplane once it has been assembled), its all-wood construction, and general weatherproof qualities, the "Imp" is simple enough in all conscience. And the view is probably very nearly as good as it is possible to obtain in an airplane of the tractor type. At the same time, the performance is approximately the same as that of other and more orthodox designs of the same power and load-carrying capacity. Put as briefly as possible, the two main objects of the design, simplicity and good view, were obtained respectively, by making the wings as cantilevers, wood-planked, and by giving the top wing a pronounced sweep back. The latter feature is clearly visible in the photographs (Figs. 2 and 3), and particularly, in Figure 1.

*From "Flight," April 12, 1928.

Wing Design

As the biplane wings are the foundation of most of the unusual features of the "Imp," they will be dealt with first. The wing section employed is a modified R.A.F. 31, i.e., a fairly thick section, with its center line curved to a medium camber. The wing arrangement chosen made a fairly thick section necessary, since the lower wing is a cantilever and has, in addition to its own load, to carry the load of the unbraced hinged upper wing. The lower wing is made in one piece, with a span of 21 ft. 6 in. and a chord of 4 ft. The upper wing is built in two halves, hinged to a central cabane of streamline steel tube. struts, and the load is transmitted via one interplane strut on each side. As the lower wing is a cantilever, while the upper is hinged, it will be seen that as far as pure bending is concerned, the inter-wing struts are tension members. With fore and aft movement of the center of pressure, however, the struts are also called upon to act as compression members, and thus are designed to fulfill both functions.

Constructionally, the wings are unusual, in that they have been designed in such a manner as to utilize the skin or planking as the chief stress-resisting member (Fig. 4). In doing this, it seems likely that a slightly greater wing structure weight per square foot is entailed, but for the price thus paid is obtained a wing of exceptional torsional rigidity, and a wing

moreover, which is to all intents and purposes weatherproof, as it does not depend upon doped fabric but has a wooden skin protected by paint. In point of fact, doped fabric as usually understood, is entirely absent. A fabric covering is used but it is not doped on, nor is it finished off with the usual pigmented dope, but with ordinary paint.

In order to make full use of the skin as the main load-bearing structure of the wing, a somewhat unusual construction has been developed. In place of the usual two-spar internal structure, there are in the "Imp" a number of light stringers, whose function is to resist shear and not bending. In place of the usual ribs there are formers of the external shape of the airfoil section. The skin itself is a spruce veneer, and is tapered in thickness according to the location in the wing. Furthermore, the spacing of the ribs is proportioned to the local stresses in such a way as to enable the skin to stand up to its compression loads without secondary buckling. It will be realized that a wing of this design is not amenable to ordinary stress calculation, and a series of tests have been carried out to determine the most economical spacing of ribs and the best thickness distribution in the skin. As a matter of fact, the resulting wings have proved a good deal stronger than required. For instance, the top wing has a factor of about 12, and the lower wing of about 8, which is higher than deemed necessary even in a single-seat fighter of more than six times the power!

One feature of the "Imp" wing arrangement will doubtless be criticised by some: there is no provision made for folding the wings. Mr. Bolas has a rather convincing, and certainly very neat reply to any such objection. "One gets" he says, "much more shed than airplane for a pound sterling." In other words, it is better economy to spend the extra cost of any folding arrangement on increased shed space. A hangar, Mr. Bolas argues, if it is to be large enough to enable the owner to work around the airplane in the folded condition, will be very little smaller than one large enough to house the airplane erected. The time has not yet come when the private owner of an airplane can keep his airplane in a small shed in his garden, and in any case, a fairly large field is still necessary for taking off and alighting. That being so, ground space for a hangar is not a serious consideration, and there remains only the question of the extra cost of the slightly larger hangar, which is met by the dictum quoted above. That, in brief, is Mr. Bolas' argument, and certainly there is a good deal of common sense in it.

The time when wing folding is really an advantage is after a forced landing in a field. But Mr. Bolas contends that when, after such an event, the airplane has to be pushed through a gateway, there will usually have gathered quite a number of people, and as the wings of the "Imp" can be dismantled in about two minutes by two people, the loss in time is not likely to be of any consequence. At present no provision has been made for

carrying the dismantled wings on the fuselage, but this will be done in future airplanes.

The one-piece lower wing rests in a cut-out in the bottom of the fuselage, and quick-release fittings are used for securing it in place and for disconnecting the aileron controls. The procedure of dismantling the wings is as follows: One man supports the upper wing tip, while a second releases the strut attachments to the lower wing. The strut can then be laid flat along the under side of the top wing, where it is held in position by a pin through a small fitting. The man on the wing tip now lowers this slightly, when the second man releases the hook attachment to the cabane and the one half of the top wing is carried away. The process is repeated for the other half.

The lower wing has, as we have said, quick-release attachments to the fuselage at what would normally be the location of the rear spar. These are released first. When this has been done, the lower wing is prevented by a spring from falling down. The two persons catch hold of a wing tip each, and press the wing backwards against the spring. After a backward movement of a little more than an inch the two pins in the front of the bottom wing come out of their sockets, and the wing is then free of the fuselage and can be carried away. The erecting of the wing is carried out in the reverse sequence.

Ailerons are fitted to the bottom wing only, and run the whole span, chiefly in order to simplify the quick-release control attachments.

The fuselage is of orthodox construction, with a light skeleton of spruce, covered with plywood. It is, of course, flat-sided, and has a flat bottom, but a cambered deck fairing in the usual way. The top longerons are placed rather higher than in some airplanes, i.e., the deck fairing forms a smaller percentage of the over-all fuselage depth, and one result of this is that it is just a little awkward to get into the cockpits, as one has to step over the top longerons. There is, however, a step on the starboard side, so placed that it is used for both cockpits.

The cockpits are roomy and comfortable, and owing to the sweep back and large cut-out of the top wing, the view from both is exceptionally good. Dual controls are fitted, and the two seats rest on a box running through both cockpits.

The Armstrong-Siddeley "Genet" engine is mounted on tubes, and separated from the cockpit by a fireproof bulkhead (Fig. 4). The gasoline tank is placed in the deck fairing ahead of the front cockpit, where it gives sufficient head for gravity feed to the engine. Thus the necessity for a center section tank is avoided, which would be difficult to fit on the wings designed, and would, moreover, obstruct the view somewhat.

The landing gear is the usual vee-type, with oleo and spiral spring "legs." The travel is about 5 inches, and the track is wide.

The main dimensions of the Parnall "Imp" shown on the general arrangement drawings are:

Length		21 ft. 2 in.
Span	Upper wing	25 " 6 "
	Lower wing	21 " 6 "

Areas:

Total wing areas	176.0 sq.ft.
Ailerons	30.7 "
Stabilizer	11.8 "
Elevators	9.8 "
Fin	1.4 "
Rudder	6.5 "

The weight of the airplane empty is 850 lb. (386 kg).

The loaded weight depends, of course, on the weight of the occupants, but 1320 lb. (600 kg) is given as an average figure. With the factors of safety as high as they are, the airplane should be quite strong enough for any load with which it could get off. The wing area being 176 sq.ft., the wing loading is 7.5 lb./sq.ft. The top speed is approximately 102 M.P.H. (164 km/h), and the landing speed about 40 M.P.H. (64 km/h).

At present we do not know at what price the Parnall "Imp" will be marketed, but doubtless an announcement concerning this will be made shortly.

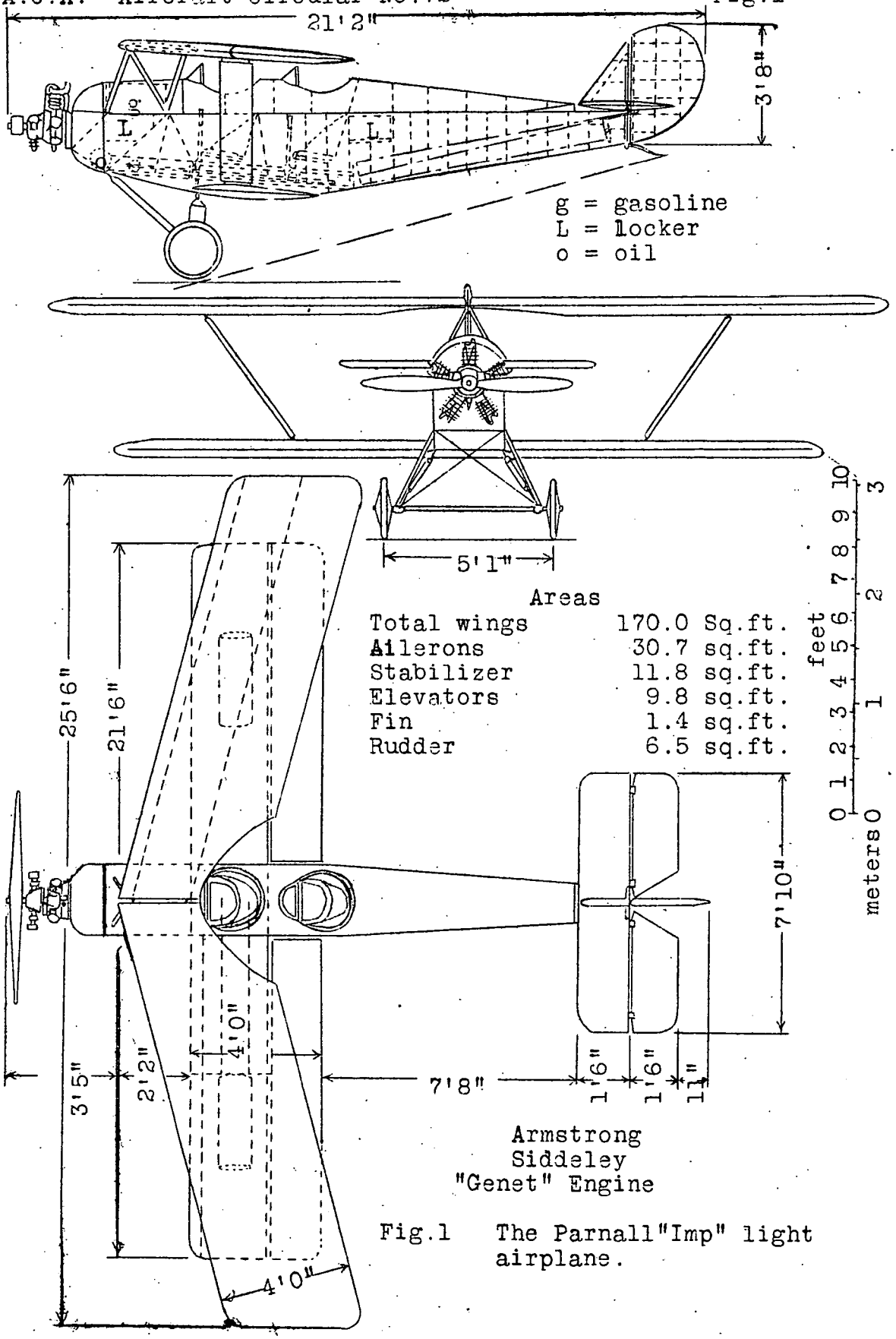

Fig.1 The Parnall "Imp" light airplane.

"Flight Photographs"

Fig.2 Three-quarter view of the Parnall "Imp" light airplane.
Note that both cockpits are clear of the top trailedge, and that by this the view is very good.

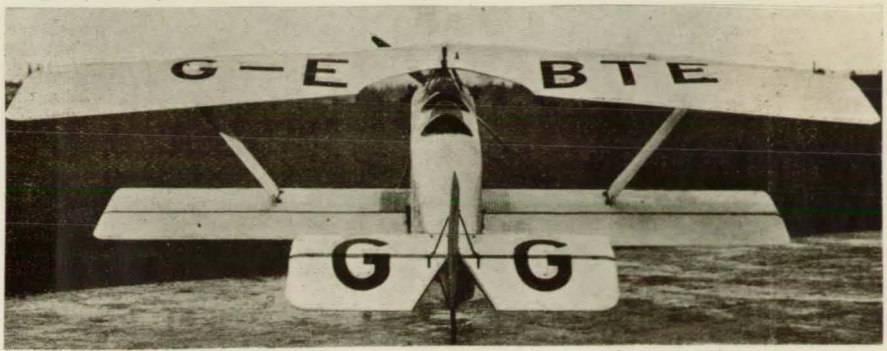

Fig.3 Rear view of the "Imp". The raked interwing struts transmit the lift from the top wing to the lower, cantilever, wing.
Ailerons run the whole span of the bottom wing.

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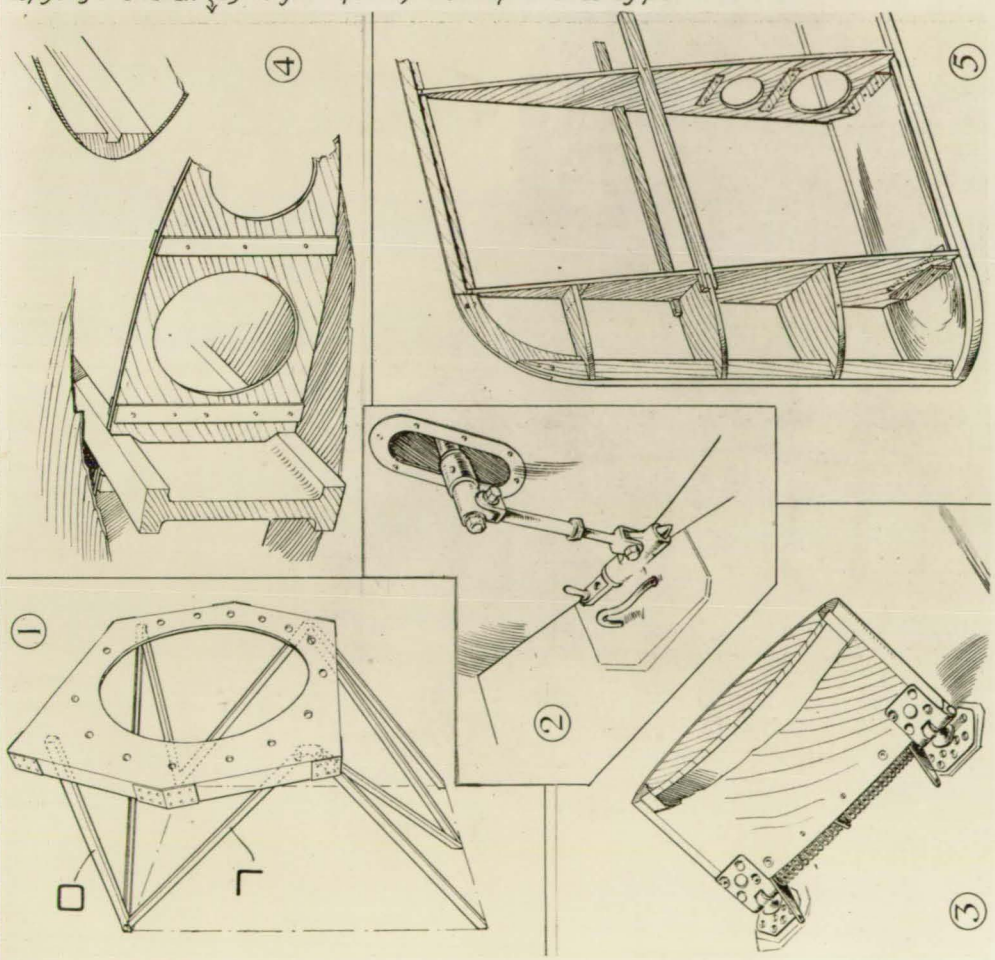

Fig.4 Some constructional details of the Parnall "Imp", light airplane. The engine plate is supported on a system of square tubes and angle sections, as shown in 1. The quick-release attachment of the aileron controls is shown in 2, while 3 illustrates the attachment of interwing struts to lower wing. The same sketch shows construction of strut. The wing structure, consisting of false spars, or stringers, and ribs or formers, with spruce planking, is shown in 4, and aileron and elevator in 5.

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